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The German Ironfoundry Industry

The Stationery Office have at long last issued the Report by Mr. R. C. Shepherd and Mr. W. R. Marsland on "Engineering Grey Iron," as B.I.O.S. Final Report No. 1237. Most of the executives of the larger ironfoundries are already familiar with the contents of this Report, as it was made the subject of a two-day congress organised by the Council of Ironfoundry Associations. Those present at this meeting, if asked to-day for their impressions of the German foundry industry, would probably state that there is little to be learnt except perhaps in the technique of core-blowing. Surely it is correct to assume that no country has a monopoly of brains, and we regard the introduction to the Report and the talk with Dr. Geilenkirchen as being of special importance. If our memory serves us correctly, there were about 1,400 ironfoundries in Germany before the war, and only seventeen were inspected. Moreover, it is not only the describable technology which characterises the efficiency of an industry, but the existence of what the Americans call the "know-how." An outstanding example of this is Herr Fraenkl's notion to make steel continuously by blowing oxygen-enriched air through a 2½-in. stream of cupola metal and finishing up with a rod rolling mill. If this inventor ever succeeds, the "know-how" will be more valuable than a patent specification!

If it can be accepted that the German ironfoundry industry possessed average units distinctly larger than the British, it must also be taken for granted that the foundry equipment available was in every way adequate. The largest concern employed under normal conditions no fewer than 860 workpeople, whereas the most important comparable British concern of this type is not half this size. The German concern is characterised, by the Authors of the Report, as a "go-ahead, live concern." The British foundry equipment industry has made truly great progress during the war, and should in a few years' time be of the same magnitude as the major continental concerns. The German progress noted was in no small measure due to the average foundry being larger than the British, coupled with a flourishing export trade. The two Reporters have done an excellent piece of work; we believe, however, that more information would have been obtained if a technical interpreter had been attached to the party. In one Report, the ordinary German word *Form* is retained in the text as being of special significance, whereas it just means, in this case, "moulding" [box].

The Report, which is essentially practical, is well worth studying, though we consider that—if mechanisation be envisaged—that Mr. Shepherd's Paper to the Nottingham Conference on this subject is infinitely more valuable. The core-blowing studies should certainly be taken seriously, as the Germans have mastered the technique very well. There may be, however, among the 2,000 iron foundries in this country, some that are equally well developed. That aspect always arises in discussions of a general nature. There is still much information to be obtained from Germany, and the Author's recommendation that further visits should be made still has much force, especially when production approaches capacity.

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Fulmer Research Institute

The official opening of the Fulmer Research Institute took place on July 2, when a large and representative company assembled to hear and see Sir Stafford Cripps perform the ceremony. In his introduction, COL. W. C. DEVEREUX, F.R.Ae.S. (chairman of the Institute), pointed out that it was nationally important to provide adequate facilities for research and development as a means of securing the rapid improvement of industrial processes and products.

This theme was elaborated by SIR STAFFORD in his speech. He gave three fundamental principles for the development of such an institute, listing them as:—(1) Provision of a first-rate staff; (2) guarantee of retention of results of any sponsoring firm; and (3) absence of the profit motive. "We, in the Government," he said, "are doing our utmost to encourage the setting up of research institutions in particular industries. Under the new Industrial Development and Organisation Act, it will be one of the functions of the development councils to be set up to encourage joint research organisations. But these alone do not cover the whole ground. There will still be the gap, when these have been set up for many more industries than have them to-day. It is for that reason that the Government welcome so heartily this initiative."

After MR. E. A. G. LIDDIARD, director of research, had spoken on the work to be undertaken by the Institute, the various laboratories and testing departments were inspected.

British Non-ferrous Federation

The second annual general meeting of the British Non-Ferrous Metals Federation was held in Birmingham on July 3, under the chairmanship of Mr. H. W. Clarke, President. At the morning meeting, the following officers were elected for the year 1947-48:—President, and chairman of Executive Committee, Mr. H. W. Clarke; Vice-Presidents, Mr. W. H. Henman, Mr. H. E. Jackson, and Mr. W. J. Terry; treasurer, Mr. R. Lloyd Gibbins.

In the afternoon, the annual meeting of the federated firms was held, at which the President presented a report for the year 1946-47. In expressing his thanks to the Federation for the confidence it had shown in him by his re-election, he said that many months had now elapsed since the final defeat of the Axis powers, but those who had envisaged a rapid return to the conditions they knew in the industry before the war had been doomed to disappointment. The manufacture of non-ferrous metals continued to be, to some extent, a partnership between H.M. Government, who were the only purchasers and suppliers of raw material to the industry, and the industry itself. The first duty of an organisation such as the Federation was to represent the industry in its relations with the Government in accordance with the best interests of all parties concerned:—Government, industry, and the general public. The correct attitude to be adopted by such an organisation was one of helpful co-operation and a readiness to understand the complicated economic problems of modern Government, tempered by a reasonable firmness on all important issues, where the vital interests of the industry were involved.

Arising out of the President's Report, a discussion took place upon the future arrangements for the purchase and sale of metals. Attention was called to the announcement of the re-opening of the Futures Market in New York for the forward purchase of copper and zinc, and the President announced that the Federation would shortly be making representations to H.M. Government stating that the industry was concerned about the continuance of bulk purchasing and considered that the time was approaching when the ban might be lifted from the London Metal Exchange, although before that was done the industry would wish to be assured of adequate safeguards to prevent undue speculation, and the exploitation of the consumer.

Chemical Society Centenary

The centenary celebrations of The Chemical Society will take place in London from July 14 to 17. The exhibition will be opened by the President of the Society (Professor C. N. Hinshelwood), at the Science Museum, South Kensington, S.W.7, at 11 a.m. on Monday, July 14. On the following day will be the reception of delegates and distinguished visitors by the President and Council at Central Hall, Westminster, followed by the opening ceremony and the centenary address by the President.

On July 16 the following lectures will be given:—(1) "Chemical Personalities a Century Ago" by Professor J. Read, at the Institution of Civil Engineers, Great George Street, S.W.1, and (2) "The Work of the Royal Institution in Physical Chemistry in Great Britain" by Professor E. K. Rideal, at the Royal Institution, Albemarle Street, W.1, both at 11 a.m. At 3 p.m. the Faraday lecture will be given by Sir Robert Robinson, followed by the presentation of the Faraday Medal in Central Hall, Westminster.

New British Standards

The British Standards Institution, of 28, Victoria Street, London, S.W.1, have recently issued their Monthly Information Sheet for May. Under "New Standard Issued" is given:—

Code of procedure in inspection of copper-base alloy sand castings (2s. 6d., 1367:1947).

This code of procedure contains recommendations concerning the inspection of copper-base alloy sand castings. Castings are classified according to the service they have to perform, and methods of inspection are suggested for each class. The methods recommended cover chemical analysis and mechanical tests, the latter including a table relating the weight of castings to the number of test-bars to be prepared. Inspection methods for castings are outlined, together with the procedures for destructive and non-destructive tests. Appendices give the dimensions of recommended standard forms of test-bar and of the standard test-piece for cast material.

Precision Casting of High Melting-Point Alloys Containing Nickel*

Part II

By H. Evans, A. Met., F.I.M., P.S. Cotton, B.Sc. and J. Thexton, A.Met., A.I.M.

This Paper is based on an investigation carried out to develop a technique suitable for the manufacture of castings by the "lost-wax" process in high melting-point nickel alloys. A procedure based on the use of zircon flour in the sprayed coating and of sillimanite in the investment is recommended.

Recommended Procedure

The procedure recommended for the production of precision castings in high-nickel alloys is described in detail below. Photographs of some of the equipment used in the development of the technique are given in Figs. 6 to 9, while the significant stages of the process, when operated on an experimental scale, are illustrated in Figs. 10 to 15.

The production of master-dies for the wax patterns has been described and illustrated in a number of articles published in the American Technical Press. Split dies for the preparation of test-bars 4 in. long by ½ in. dia. and creep test-pieces were machined in the normal way, from steel and brass respectively.

Wax Patterns

A very thin film of condensed ethyl silicate is applied to the faces of the die, see Fig. 6, with a piece of cotton wool, to prevent sticking of the wax. The wax is held at a temperature of 85 deg. C. in the injection machine, of which a diagrammatic drawing is presented in Fig. 7. The inner container is surrounded by an electrically heated water bath, which is thermostatically controlled. The die is clamped on to the injection machine, with the injector nozzle in the gate of the metal die. Injection of the wax is carried out by applying an air-pressure of 50 lb. per sq. in. to the surface of the molten wax. When the wax pattern is cool, it is removed from the die and a short length of wire, with a loop at one end, is inserted into the end of the pattern. The pattern is suspended in still air and allowed to harden for about one hour. Wax patterns of cylindrical test-bars, creep test-bars and turbine blades in the process of hardening are shown in Fig. 10.

Assembling.

The wax patterns are mounted, with the aid of a heated spatula, on to a previously-made wax feeder-head. The complete assembly is then cleaned by wiping with a piece of cotton wool wetted with methylated spirit. Mounted patterns are illustrated in Fig. 11.

Spraying of Assembled Pattern

The pattern assembly is sprayed with the following mixture:—

Zircon flour (-200 mesh)	100 gm.
Ethyl silicate stock solution* ..	17 ml.
Industrial methylated spirit ..	29 ml.
Hydrochloric acid (10 per cent. by volume of 1.16 S.G. acid in methylated spirit)	5 ml.

The purpose of the small addition of hydrochloric acid to the spray mixture, and to the investment mixture used subsequently, is to accelerate the hydrolysis of the ethyl silicate and so decrease the drying-time. Spraying is carried out in a cabinet, with a paint-spraying gun having an unrestricted circular nozzle

* Condensed ethyl silicates (containing 40 per cent. SiO_2)	75 per cent. by vol.
Water	7 per cent. ,,
Ethyl alcohol	18 per cent. ,,

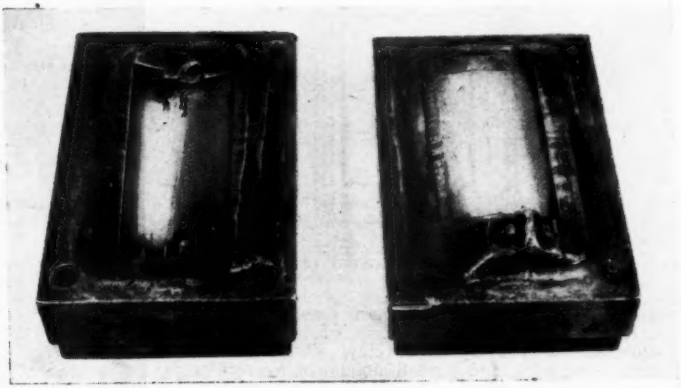

FIG. 6.—SPLIT DIE FOR THE PREPARATION OF WAX PATTERNS OF TURBINE BLADES.

* Paper read at the 44th Annual Conference of the Institute of British Foundrymen at Nottingham, June 19.

Precision Casting

aperture of $\frac{1}{16}$ in. and operating at an air-pressure of 50 lb. per sq. in. Agitation of the mixture in the gun during spraying is essential. This is conveniently carried out by passing air through a perforated spiral tube in the spray gun container (Fig. 8).

The patterns are held approximately 18 in. from the spray nozzle, and an even coating of approximately 0.008 in. is applied over the whole surface. The patterns are then left to dry in air for 12 hours, after which a second coating is applied, following exactly the same procedure as for the first application. The sprayed patterns are shown in Fig. 12. When the second coating has dried for 3 hours in air, the patterns may be invested. The pattern assemblies are mounted (feeder-head down) on metal plates, again by use of a heated spatula. A cardboard tube (Fig. 12) of suitable size is then placed round each pattern assembly and secured to the plate with wax, to form the moulding flask.

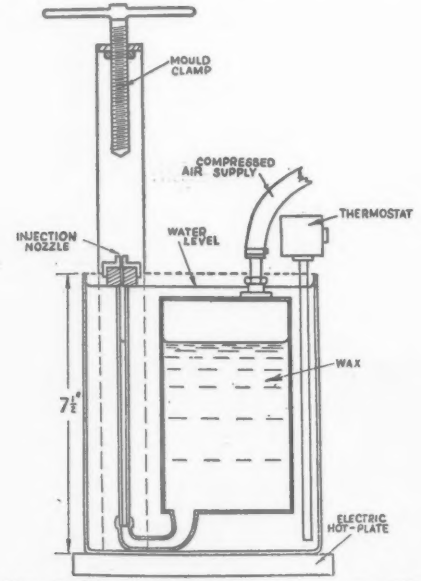

FIG. 7.—DIAGRAMMATIC DRAWING OF THE WAX INJECTOR.

Investment of the Sprayed Pattern Assemblies

The investment-mixture consists of two grades of sillimanite with a binder of ethyl silicate solution, methylated spirit, and a small amount of hydrochloric acid. These are mixed in the following proportions:—

Sillimanite "30 mesh" grade	...	3,000 gm.
Sillimanite "FF" grade	...	375 gm.
Ethyl silicate stock solution	...	281 ml.
Industrial methylated spirit	...	827 ml.
Hydrochloric acid (S.G. 1.16)	...	17 ml.

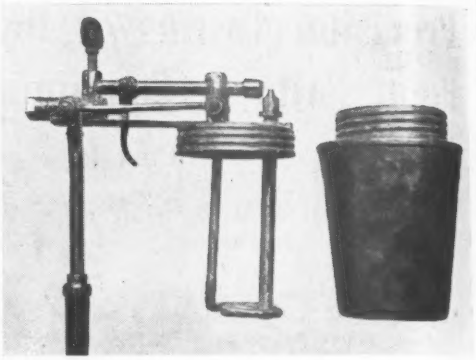

FIG. 8.—COMPRESSED AIR SPRAY GUN, STRIPPED DOWN TO SHOW SPIRAL USED FOR AGITATING THE SPRAY MIXTURE.

The IMM screen analysis of the "30 mesh" grade sillimanite is as follows:—

IMM screen size	−20 +30	−30 +60	−60 +80	−80+100	−100
Percentage	5	28	12	2	53

FIG. 9.—BIRLEC-DETROIT MODEL "N" MELTING FURNACE WITH MOULD IN POSITION.

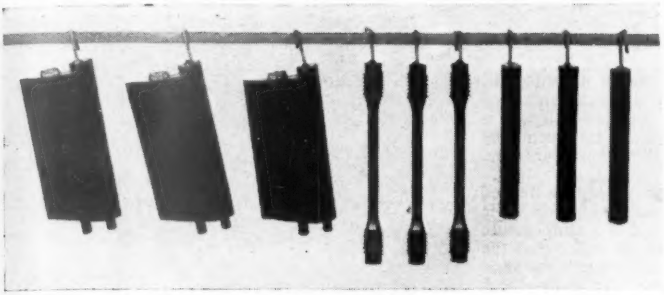

FIG. 10.—WAX PATTERNS PRIOR TO MOUNTING ON FEEDER-HEADS.

The "FF" grade sillimanite includes 99.8 per cent. of −200 mesh. The two powders are mixed together in the dry condition by hand. The liquid binder is made up by mixing the stock solution and methylated spirit in a container and then adding the hydrochloric acid while the mixture is well stirred. The addition of the mixed sillimanite powders to the binder is carried out slowly, to produce an investment slurry of uniform consistency.

The moulding flasks are placed on a cam-operated vibrating table and the investment slurry is poured in, to a height of 6 in. above the top of the patterns. The table vibrates 300 times per minute, has a vertical travel of $\frac{1}{32}$ in., consolidates the refractory powder around the coated wax assembly in the lower part, forces the excess liquid into the upper part of the container and removes all the air from the mixture. Vibration is carried out for a period of 1½ to 2 hours, when the mixture should have consolidated to a depth of about 1½ in. above the wax patterns employed. The excess liquid is then poured off. After vibrating for a further period of ½ hr., during the early part of which time a little more liquid rises to the top and is poured off, the top surface should appear dry. A layer of ¼ in. to ½ in. thick of the investment is then cut off the top and vibration continued for a further period of 15 minutes.

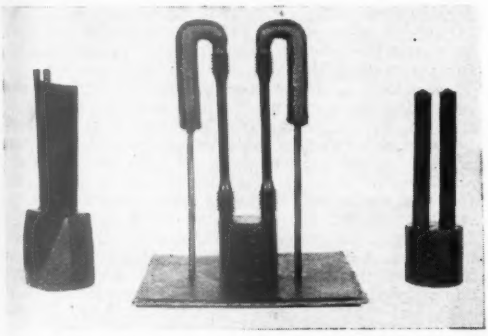

FIG. 11.—WAX PATTERNS MOUNTED ON WAX FEEDER-HEADS.

Drying of the Invested Assemblies

When the investment process is complete, the moulds are transferred to a drying oven maintained at a temperature of 35 to 45 deg. C. The oven used for this purpose is of the type normally used for drying sand moulds. Baking is carried out for a period of about 48 hours to ensure complete drying of the investment. The bottom plates of the moulds are removed after 12 hours, to facilitate evaporation of the methylated spirit.

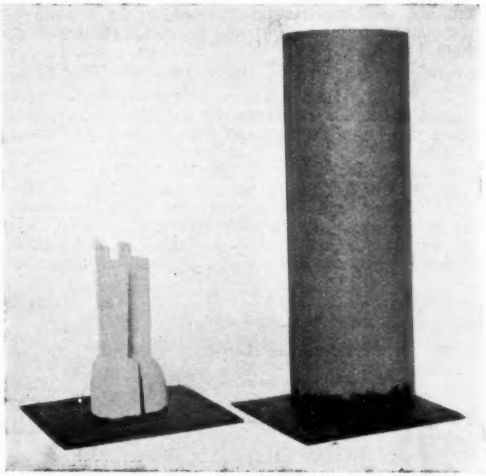

FIG. 12.—SPRAYED PATTERN ASSEMBLIES BEFORE AND AFTER ATTACHING CARDBOARD MOULDING FLASK.

Melting-Out of the Wax Patterns followed by Firing of the Moulds

After drying, the moulds, still inverted, are heated to approximately 200 deg. C. to melt out the wax. Two hours is usually sufficient for this operation, after which the moulds are transferred to a muffle furnace initially held at 200 deg. C. The temperature is slowly raised to that required for casting, usually 850 to 1,000 deg. C.

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The rate of heating should not exceed 100 deg. C. per hour. This treatment removes all wax remaining from the melting-out process, but the main purpose is to bring the moulds to the temperature at which they are to be used. Cooling to room temperature and re-heating is not recommended.

The cardboard moulding tubes are, of course, burned off on firing. The fired investment should be quite strong and free from cracks. A mould at a temperature of about 1,000 deg. C. is employed, in order that the thin sections of the casting will be adequately run, and excessive chilling of the molten alloy is prevented. A sillimanite investment, after firing, should have a compressive strength, of not less than 250 lb. per sq. in. at room temperature. Photographs of sections of two moulds, showing the fine-grained zircon coating and the coarser-grained sillimanite moulds, are presented in Figs. 13 and 14.

Casting of High-Nickel Alloys into the Fired Moulds

When the molten charge is at the required temperature, the mould is transferred as quickly as possible from the firing furnace and brought into position for casting. Two types of melting furnaces have been used satisfactorily during the investigation:—

(*a*) An indirect arc furnace, the Birlec-Detroit Model "N," with a chrome-magnesite lining capable of melting 10 lb. of raw materials or bar stock. The design of the furnace enabled the molten alloy to be poured directly (with or without the application of an air-pressure of 5 lb. per sq. in. during feeding) into the mould, clamped on top of the furnace (Fig. 9), or to be poured into a hot hand-ladle and from the ladle into the mould.

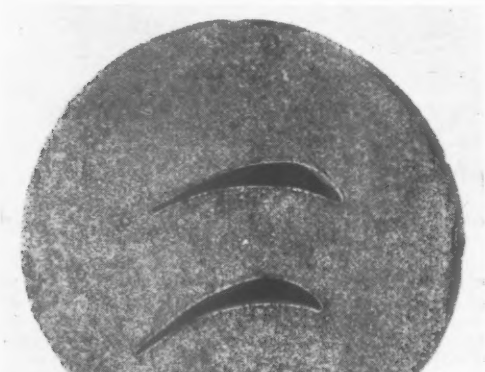

FIG. 13.—TRANSVERSE SECTION THROUGH A FIRED MOULD, SHOWING PATTERN SPRAY COATING AND INVESTMENT.

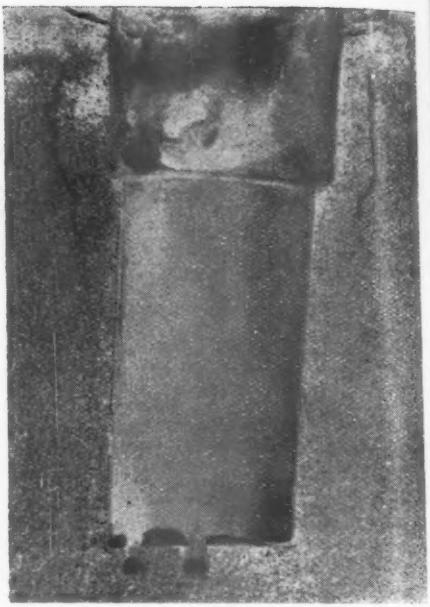

FIG. 14.—LONGITUDINAL SECTION THROUGH A FIRED MOULD.

(*b*) A 35 k.V.A., spark-gap operated, high-frequency furnace, with fireclay, sillimanite, or magnesia crucibles capable of melting 18 lb. of raw materials or bar stock. To assist the feeding of the castings made from this furnace, anti-piping compounds were employed.

In making a casting according to the recommended procedure, the metal-temperature and mould-temperature employed depend on the intricacy of the casting to be produced. For gas turbine blades with very thin edges, a pouring-temperature of 1,600 deg. C. and a mould-temperature of 1,000 deg. C. are recommended for "Nimonic 80." For simpler shapes, such as straight cylindrical test-bars, the alloy can be cast at 1,560 deg. C. into moulds at 850 deg. C. The temperature of the melt is measured with a platinum/platinum-rhodium thermocouple, protected with a silica sheath, and coupled to a quick-reading potentiometer.

Typical "Nimonic 80" castings produced by the above process are illustrated in Fig. 15. Inspection methods involving X-ray examination, macro-etching and electro-machining, have confirmed that castings made by the above process are free from internal and surface defects.

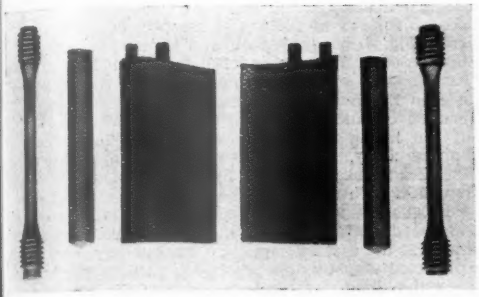

FIG. 15.—TYPICAL "NIMONIC 80" CASTINGS AFTER SHOT-BLASTING.

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New B.I.S.R.A. Laboratories

Mr. G. H. Latham, President of the British Iron and Steel Research Association, performed the opening ceremony at the new South Wales Laboratories, Sketty Hall, Swansea, on July 3. The facilities provided are comprehensive, mainly intended for work to be carried out in the investigation of problems concerned with coatings for steel, while a section will be devoted to the investigation work in South Wales of the Steel-making Division. Sir Charles Goodeve expressed his sense of the appropriateness of Swansea as the venue for the opening of B.I.S.R.A.'s first independent laboratory for co-operative research, and was pleased that close liaison was possible between the laboratories and the nearby University College of Swansea.

A Drysand Core is Suggested

By W. Gudgeon

A casual suggestion by the foreman that the casting, shown at Fig. 1, might be more easily moulded with a drysand core instead of the usual greensand one was acted upon, though opinions as to its success were not unanimous. The pattern is of cast-iron, has two loose core prints attached, 18 in. by 14 in., with an opening 10 in. wide by 14 in. long. The pattern leaves its own core, the top of the pattern consisting of a loose plate with a hole in it, the plate being replaced after ramming the core to the top of the pattern.

It was immediately recognised that the core must be so built up that sagging could not take place, for if this should happen, much labour and irritation would result. To make this possible, two grids were used, the first or bottom grid being made stronger than the second to take all the weight while hanging in the crane.

For this purpose, two mild-steel staples are included in the grid to which are fixed two loose lifting-hooks, these coming up through the core and nearly level with its surface. Two other staples are also cast in the grid, to each of which is attached two loose hook-bolts, as at A, Fig. 5, entering slots at A, Fig. 4.

In building up the core, a thin layer of oil-sand is laid on the core plate and the grid bedded on to it. This grid is shown at Fig. 3 and the method by which the hooks are fixed is shown at Fig. 5. The pattern is then lowered over the grid and on to the core plate and a layer of sand rammed over the grid. 1½ in. of sand is patted tightly against the inside of the pattern to a depth of about 6 in. after which the centre is filled and rammed solidly with ashes, a vent being led through the bottom of the grid. This procedure follows to the top of the prongs, when the top grid, Fig. 4, is lowered on and securely bolted to the bottom one. The remainder of the core is then rammed, bringing the ashes within two inches of the top. Sand is then rammed over the ashes and the loose top-plate bedded on and, after securing an impression, the tops of the lifting-staples are exposed and the pattern is hoisted away. The core, when finished, is shown at Fig. 2 and measures 3 ft. by 1 ft. 6 in. diameter and thickness of metal round the core is ⅜ in.

Because of the absence of a core print, it was considered doubtful whether the core could be set centrally at the first attempt. To remove any uncertainty connected with this operation, the pattern was lowered over the dried core and delivered to the moulder, so that its withdrawal, after moulding operations, would leave the core dead central in the mould.

Lowering the pattern over the dried core was satisfactorily accomplished by rapping it continuously with a mallet, its own weight slowly bringing it to rest on to the core plate. The change-over from a greensand core to one of drysand made more easy the moulding operations, especially when setting the two cores, which form the pads on the outside of the cylinder. Much skill and patience was always necessary when setting these cores in their prints to prevent their scraping the greensand core and the moulding of two more of these castings, after the first experiment, proved that the drysand core resulted in a cleaner and sounder casting so that its employment for repeat orders was accepted without question.

FIG. 1.

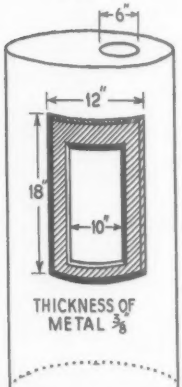
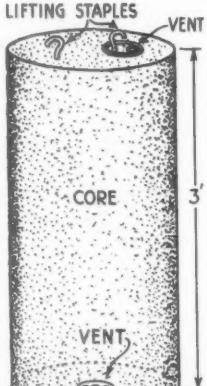


FIG. 2.



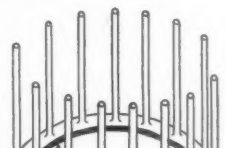


FIG. 3 (*lower left*).—BOTTOM GRID.

FIG. 4 (*top left*).—TOP GRID.

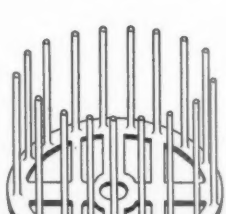


FIG. 5 (*lower right*).—BOTTOM GRID WITH LIFTING HOOKS.

Control of Bronze Melts for the Production of Pressure Tight Castings*

By W. A. Baker, B.Sc., A.I.M.

During the past ten years, the B.N.F.M.R.A. has investigated the causes and methods of controlling porosity in tin bronze castings. Three Papers have been published, which present the experimental data in detail and discuss the mechanism involved in the formation of porosity and the effect of the porosity on the properties of castings. The object of the present Paper is briefly to review the work done and to discuss its practical application, with particular reference to the production of sand castings required to be pressure tight in service, in such applications, for example, as valves, pumps and steam fittings.

Sand castings of this type are commonly made in phosphor bronze, gunmetals and leaded gunmetals, which collectively may be called the tin bronzes. The choice of these alloys for such components arises from one or more of the following notable characteristics:—

(*a*) High resistance to corrosion in marine or other corrosive environments.
(*b*) Good bearing and wear-resisting properties.
(*c*) Good casting characteristics.
(*d*) Good machining properties.

These properties are combined with moderate strength and ductility, but in most applications of these alloys, considerations of strength are secondary to one or more of the properties cited above.

The order of importance of the above characteristics obviously varies from application to application, but the order given is probably correct for the majority of cases. Thus the casting characteristics of the tin bronzes are probably third in the order of importance of their notable properties, and the object of this Paper is to discuss these characteristics and to make practical recommendations, with a view to exploiting them to the maximum possible advantage.

Copper-base casting alloys are frequently described as belonging to either the high or the low shrinkage type, the high-tensile brasses and aluminium bronzes being typical of the first class and the various tin bronzes typical of the second. The classification arises from the fact that, in the first type of alloy, freezing shrinkage commonly leads to large pipes in feeder heads and runners, etc., whereas in the second type, large shrinkage pipes occur far less frequently. Strictly speaking, however, the classification is something of a misnomer, because, in fact, the actual freezing shrinkages of the two types are not very different as can be seen from Table I. The distinctive difference between the alloys is that the first type freezes over a relatively short temperature range, while the second type freezes over wide ranges, indicated in Table I.

The practical consequence of this difference is that, in the first type of alloy, freezing shrinkage produces relatively large but few cavities, and massive feeder heads are required to ensure that these cavities occur in the feeder heads and not in the casting proper. On the other hand, in the second type of alloy, freezing shrinkage produces minute, intercrystalline cavities which tend to be widely dispersed through the casting and/or feeder heads. Moreover, an appreciable amount of this dispersed porosity is usually present in the casting without serious detriment to the appearance of machined surfaces or to the serviceability of the casting. It is for this reason that it is normally possible to make serviceable castings in tin bronzes without resorting to elaborate and expensive feeding and chilling techniques, and this characteristic is very attractive on economic grounds.

However, it is common experience that intricate castings of these alloys are liable to leak under pressure in certain parts. The leaks vary from very rapid ones, in the worst cases, to relatively slow seepage in mild cases, the latter being more common.

Causes of Gas Unsoundness in Tin Bronzes

At the outset of the B.N.F.M.R.A. research programme, there was a wealth of literature available on bronze sand-casting practice, in which this leakage trouble was almost invariably attributed to gas porosity. Numerous different melting practices were advocated, based upon practical experience in large scale operations. There was considerable difference of opinion as to the identity of the gas or gases causing the porosity, some authors ascribing it to hydrogen and others to water vapour, sulphur dioxide, or oxides of carbon. It was, therefore, essential, in the first place, to establish the effect of various gases which might be present in bronze melts and this was done in

TABLE I.—*Shrinkage Characteristics of Copper-Base Casting Alloys.*

Alloy	Freezing shrinkage volume change, liquid to solid, expressed as percentage of volume at room temperature	Freezing range, deg. C.
Aluminium bronze (90 : 10)	4.6 (*a*)	10
Manganese bronze (High-tensile brass)	5.2 (*a*)	30
92 : 8 Tin bronze	5.8 (*b*)	200 approx.
85/5/5/5 Leaded gunmetal	5.6 (*c*)	675 approx.*
	7.0 (*a*)	

(*a*) N.B. Pelling and T. E. Kihlgren, T.A.F.A., 1932, **40**, 201; (*b*) K. Bornemann and F. Sauerwald, Z. Metallkunde, 1922, **14**, 145, 254; (*c*) C. M. Saeger and E. J. Ash, U.S. Bur. Stds., J. Res., 1932, **8**, 37, Res. P. No. 399. * Most of the metal freezes over a range of the order of 200 to 250 deg. C., the very extended range quoted being due to the residual lead which freezes at 327 deg. C.

* Paper No. 880 presented at the 1947 Conference of the Institute of British Foundrymen at Nottingham.

Control of Bronze Melts

small-scale laboratory tests using closely controlled melting and casting conditions. The results of this work were published in a paper to the Institute of Metals 1941, *67*, 231-255, showing that while slight gas unsoundness did arise from the oxides of sulphur and carbon, the amount was very small in comparison with that arising from hydrogen or water vapour. Melting and casting a straight copper-tin bronze in atmospheres containing hydrogen or water vapour caused marked gas unsoundness, the gas porosity arising from the evolution of hydrogen and steam respectively during solidification. However, if the bronze contained small quantities of phosphorus or other elements with high affinity for oxygen, the solubility of oxygen in the melt was reduced to a very low value so that practically none was available to recombine with hydrogen during solidification and virtually all the gas porosity was due to hydrogen, whether the melt was prepared in a hydrogen or steam atmosphere. Since the alloys used in industry invariably contain phosphorus and/or zinc, it may be safely concluded that gas porosity in industrial bronze castings is almost entirely due to hydrogen dissolved in the liquid metal and rejected from solution during freezing.

Degassing Methods for Tin Bronzes

Following this stage of the work, somewhat larger scale laboratory tests were made, to establish reliable degassing methods for typical alloys, namely, straight tin bronzes with small residual phosphorus contents (from deoxidation with phosphor copper), phosphor bronzes and gunmetals. The results of this work were published in a second paper to the Institute of Metals 1944, *70*, 349-371, showing that the well-known practice of melting in oxidising atmospheres, or of adding oxidising fluxes, etc., to the melt, was extremely effective with the straight tin alloys substantially free from powerful deoxidants. For alloys containing appreciable quantities of zinc and/or phosphorus, however, such treatment was much less effective. This result was to be expected from the fact that these elements markedly lower the solubility of oxygen in the molten alloy, so that hydrogen dissolved in the metal is less easily removed by oxidation to form steam. Since nearly all the industrial alloys for sand castings are of the latter type, alternative methods of degassing were studied, based on the well established fact that the solubility of hydrogen in metals is proportional to the square root of its partial pressure in the atmosphere surrounding the melt.

Thus, if a melt containing hydrogen is held in a suitable inert atmosphere for a sufficiently long time, the hydrogen diffuses into the surrounding atmosphere until the gas content of the metal is negligibly small. This process can be accelerated by increasing the exposed surface area of the metal, and it was shown that, if the metal bath is vigorously agitated in a continually replaced atmosphere (virtually free from hydrogen or steam, etc.), the hydrogen in the melt rapidly escapes into the atmosphere and is swept away. The process is frequently referred to as a scavenging treatment. For laboratory purposes, melts were thoroughly degassed very rapidly by passing a stream of dry nitrogen through the melt for five minutes at a speed such that the metal was violently agitated, but other methods, for more convenient application in practice, were also examined, two of which present relatively little difficulty in practical application.

The most convenient of these is a treatment using manganese ore in which the ore is charged on the bottom of the crucible where it slowly decomposes during melting of the charge to liberate oxygen and carbon monoxide which steadily bubble up through the molten metal. The oxygen evolution occurs fairly early during the melting process since the manganese ore (MnO_2), dissociates to Mn_3O_4, at temperatures of the order of 700 deg. C. Nevertheless, gas continues to be evolved throughout the melting period and although it occurs fairly slowly, causing a gentle agitation of the melt, it carries on for a long time and is found to be very effective.

It is believed that the Mn_3O_4 reacts with graphite in the melting crucible to liberate carbon monoxide which scavenges the melt. The amount of manganese ore charged is usually of the order of 1 per cent. of the melt weight and the only important point to note is that the ore must remain at the bottom of the crucible throughout melting. If it floats to the surface, or if it is charged on the surface of the melt, it can only exert an oxidising effect and the desired scavenging effect is lost. The second process developed involves the treatment of the melt with carbon dioxide obtained as a decomposition product from marble chips.

One convenient method, used to introduce this material, employs a salamander tube about 3-ft. long, about 1½-in. internal diameter and ½-in. wall thickness, closed at one end. Marble chips equal to about ¼ to ½ per cent. of the melt weight are inserted loosely in the open end of the tube and the aperture roughly blocked with a piece of crumpled copper foil. The tube is then inserted in the molten metal, open end downwards, and the heated marble evolves carbon dioxide which bubbles up vigorously through the melt.

Experiments showed that this process was rather more certain in action than the manganese ore treatment when applied to phosphor bronzes, because in the case of phosphor bronze melts, the evolution of gases from the manganese ore is less marked, presumably because the phosphorus reacts rapidly with the manganese oxides to form phosphates and so tends to inhibit the gas-forming reactions.

Pell-Walpole* has described an oxidation treatment for degassing bronzes which uses a copper oxide, borax and silica sand mixture, whose copper oxide content can be varied to vary the degree of oxidation. The flux has the merit of cheapness and, perhaps more important, attack on melting crucibles is very slight and, where necessary, can be minimised further by increas-

* W. T. Pell-Walpole, Journal Inst. Metals, 1944, 70, 127-147.

ing its silica content. Tests in the laboratories of the B.N.F.M.R.A. have shown, as was expected, that phosphor bronze melts, containing dissolved gases, are not degassed by application of this flux, even for prolonged periods. On the other hand, with the gas-fired and coke-fired furnaces used in the Association's laboratory, it has long been the experience that bronze melts are much less readily gassed than might perhaps be expected and in most of the work on degassing methods, the bronze melts were deliberately gassed by treatment with hydrogen before applying oxidising treatments, etc.

It was not surprising to find, therefore, that if the flux advocated by Pell-Walpole is charged at an early stage during melting in such furnaces, the melts so produced are substantially free from gas and it seems likely that, used in this way, the flux may have a blanketing effect, tending to minimise still further, any gas absorption by the melt from the furnace atmosphere. Bearing in mind the simplicity of the treatment and the potential saving by reduction in melting losses, this melting practice for the various tin bronzes deserves careful consideration, notwithstanding the disclaimer that oxidation of alloys containing phosphorus or zinc is not likely to remove hydrogen already present in the metal.

The Effect of Shrinkage and Gas Unsoundness in Bronze Sand Casting

Following the development of satisfactory methods for degassing on a reasonably large scale, research was directed to examine the precise effects of shrinkage and of dissolved gases on the properties of bronze sand castings. Practical experience shows that if a bronze casting leaks under pressure, the leakage invariably occurs in certain parts of the casting where changes in section, junctions of section, bosses or ribs, cause solidification to be locally delayed. Accordingly a disc casting, exhibiting one of these typical features, *i.e.*, a central boss, was selected for test purposes, and sand castings of this form were made in straight tin bronze, phosphor bronze and gunmetals.

At an early stage, it was found that phosphor bronzes absorbed hydrogen when cast into sand moulds, so that degassed alloys yielded sand castings containing substantial amounts of hydrogen gas porosity. The identity of the gas was established by extracting samples from unsound castings and it was shown that the amount of gas absorbed by the casting increased with the phosphorus content of the alloy and with the pouring temperature used. Drying the sand mould at ordinary stoving temperatures did not prevent gas absorption, although it was somewhat reduced; to avoid it altogether, it was necessary to stove the mould at very high temperatures, *e.g.*, 900 deg. C., such that the clay-bond was substantially dehydrated. The gas absorption could also be inhibited by adding to the alloys small amounts of silicon of the order of 0.3 to 0.5 per cent., which protected the molten metal by a tenacious film, presumably of a complex silicate, and the castings obtained were free from gas unsoundness and were notable for their remarkedly smooth cast surfaces. In later work it was found that aluminium paint* on the mould faces largely inhibited the gas absorption.

Thus it became necessary to examine, not only the effect of shrinkage and of gas initially dissolved in the bronze melt, but also to examine the effects of hydrogen entering the casting by reaction with moisture in sand moulds and these three effects were studied in straight tin bronzes, phosphor bronzes, gun metals and leaded gunmetals.

The general line followed was to make large numbers of disc castings in each alloy, some substantially free from gas porosity from either source, some containing gas porosity due to gas in the metal before casting, and some made from degassed alloys which were allowed to absorb gas in the sand mould. The casting was gated in such a way that it was imperfectly fed and when precautions were taken to avoid either source of gas absorption, it was found that the disc casting tended to leak under pressure in the vicinity of the boss, either before or after machining off the cast surfaces. Detailed examination of such castings showed that the shrinkage porosity was concentrated in the immediate vicinity of the bosses and consisted of small intercrystalline cavities that interconnected, thus explaining the leakage under pressure.

When gas was present in small amounts in the metal before pouring, it had a beneficial effect, in that, although the total amount of porosity in the disc casting was substantially unchanged, its distribution was quite different in the presence of gas. The amount of porosity in the vicinity of the boss was markedly reduced and the amount in adjacent thinner parts of the disc was appreciably increased. Thus, a much larger proportion of the castings were pressure tight, because the more widely distributed porosity was not sufficiently concentrated near the boss to form connected cavities. Also, the tensile strength of specimens from the vicinity of the boss was correspondingly improved.

Even better results were obtained when the gas was derived by reaction between the metal and moisture in sand moulds. Thus, when the melt was freed from dissolved gas and its phosphorus content was adjusted to promote some gas absorption in the mould, the porosity was distributed even more uniformly through the castings, and the percentage of pressure tight castings was further improved, as also was the tensile strength of specimens cut from the vicinity of the boss.

Results typical of the above findings were illustrated, in a Paper to the Institute of Metals, 1944, *70*, 373-406, by a series of curves showing the pressure tightness and strength of specimens cut from disc castings plotted against the gas content of the metal; the gas content of the metal being indicated by the densities of separately cast test bars from the same melts. These test bars were well fed, so that gas porosity, arising either from gas in the metal before pouring or from

* Pell-Walpole (Metal Industry, 1946, 69 (7), 129) recommends aluminium paint for chill moulds and reports that the coating does not cause marked "gassing" of phosphor bronze. This suggested the present application to sand moulds where a resinous base paint largely inhibited gas absorption. The paint was usually applied, admixed with paraffin, which was burnt off in gentle skin drying with a torch.

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gas absorbed from the mould, caused a reduction in the density of the bar and a corresponding reduction in its tensile strength.

The experiments showed that the various alloys behaved somewhat differently, for example, the straight tin bronzes or phosphor bronzes (of low phosphorus content or alternatively cast in inhibited moulds to prevent gas absorption in the mould) were most prone to localised shrinkage porosity, gunmetals were rather less so, and the leaded gunmetals were least prone. For the last-mentioned alloys, it was necessary to restrict the feeding of the test casting even more drastically, in order to produce localised shrinkage and leakage under pressure. When this was done, the introduction of gas was beneficial as for the other alloys. These differences between the alloys, however, are differences of degree and are in no sense absolute, and for all the alloys it is concluded that leakage in sand castings subjected to fluid pressure is usually due to localised shrinkage porosity. This difficulty can be minimised, or avoided altogether, by deliberately producing a suitable amount of gas unsoundness, preferably by promoting some gas absorption in the sand mould.

Practical Recommendations for the Production of Pressure Tight Bronze Sand Castings

It will be appreciated that the work described must be regarded as revealing and demonstrating the general principles to be followed in bronze sand casting practice, rather than precise details of the practices which will be applicable to the wide variety of castings made. The important practical recommendations can be expressed in general terms as follows:—

(1) For all castings, the molten alloy should be thoroughly degassed by one or other of the three methods described.

(2) For simple forms of casting, where cross-sections are uniform and where substantially complete feeding is practicable and economic, the phosphorus content of the alloy and the pouring temperature used, should be kept at the lowest level compatible with other considerations. For high phosphorus bronzes, *e.g.*, for gears and bearings, it will also be desirable to use inhibiting paint on the mould surfaces, in order to minimise gas absorption in the mould.

(3) For more intricate castings of variable section where complete feeding is impracticable or uneconomic, the phosphorus content of the alloy and the pouring temperature should be raised to levels which will cause a moderate amount of gas absorption in the mould; in this way, the porosity, inevitably present in the casting, will be distributed as uniformly as possible, with resultant improvement in what would otherwise be the most porous parts of the casting. Again, further improvements may be sought, if economic considerations permit, by the local application of inhibiting mould paint; in this case, the aluminium paint should be applied only to those parts of the mould cavity where solidification is liable to be delayed, *i.e.*, to the site of bosses, junctions of sections, etc.

Test Bars for Control Purposes

In order to put these practical recommendations into effect, it is necessary, or at least very desirable, to have some simple means of confirming that the melt is adequately degassed as recommended. The simplest procedure for this purpose is to cast a well-fed test bar in a mould coated with inhibiting paint and dried. Bearing in mind the recommendations of the recent draft Code of Procedure published by the B.S.I., it is recommended that the wedge-type shaped bar, described therein, be cast in this way as an occasional check on melting practice.

Similarly, it is desirable that where gas absorption in the mould is used to improve intricate castings as already described, occasional test bars should be cast in uninhibited green sand to ensure that variations in the sand are not causing variations in the amount of gas absorption. The amount of gas absorption can be judged by the reduction in density and/or strength of these test bars, compared with the properties of bars cast in inhibited moulds.

It must be emphasised that test bars cast under these, or for that matter, any other conditions, only reflect the condition of the metal and its behaviour when cast into that particular test bar form. They can only be used, therefore, as a general guide in the application of the recommended procedure for the production of pressure tight castings, and must not be construed as providing any evidence of the properties of the production castings.

Recommended Procedure in Choosing Appropriate Pouring Temperature and Phosphorus Contents for Particular Castings

Where large numbers of identical or similar types of castings are made, the following procedure is recommended to arrive at the most favourable combination of phosphorus content in the metal and pouring temperature for the job. Assuming that the metal is degassed by one or other of the processes already detailed, and that the effectiveness of the procedure adopted has been confirmed by the use of test bars, a number of castings should be made with the phosphorus content of the metal and the pouring temperature at the lowest practicable level consistent with the requirements of specifications and with freedom from misruns in the casting. If the resulting castings exhibit any drawing or leakage at local changes of section, etc., the pouring temperature and/or the phosphorus content should be increased until these defects are eliminated.

It is not possible to lay down hard-and-fast rules applicable to all castings, but, to judge from laboratory test results, the appropriate pouring temperatures and phosphorus contents for gunmetals and leaded gunmetals are likely to lie in the range:—Pouring temperature, 1,080 to 1,180 deg. C.; phosphorus content, 0.01 to 0.10 per cent.

For gunmetals and leaded gunmetal castings of simple form, which can be easily fed and in which the maxi-

mum overall soundness is desired, it is likely that material with the phosphorus content at the lower limit and cast at a relatively low temperature will give the desired result. The application of inhibiting paint to the mould surfaces is unlikely to offer attractive benefits. Also, for castings of intricate form, suitable adjustment of the phosphorus content and/or pouring temperature, is likely to be adequate to give the required distribution of porosity in such castings, but for particularly difficult castings, it may be advantageous to apply inhibiting paint where leakage troubles persist.

For some phosphor-bronzes, where the specification for the material, or considerations of its wearing or bearing characteristics, may define the lower limit for phosphorus content, the pouring temperature may be the only variable which can be controlled for the present purpose, and the permissible temperature is likely to be in the range:—For 0.25 per cent. phosphorus, 1,050 to 1,150 deg. C.; for 0.50 per cent. phosphorus, 1,020 to 1,120 deg. C.

If, with the lowest permissible pouring temperature and phosphorus content, there is still an undue amount of porosity in castings of simple form, where maximum soundness is desired, inhibiting paint applied in an inflammable solvent is recommended. For more intricate castings, where some gas absorption in the mould is desirable, and where the phosphorus content and pouring temperature have been adjusted accordingly, these adjustments alone will normally be sufficient, but, for particularly stubborn cases, the local application of inhibiting mould paint is worth bearing in mind.

The above trial and error procedure would obviously be practicable only where large numbers of castings were involved, but it is reasonable to suppose that experience in the application of the process would make it possible to choose the correct conditions for new jobs with little risk of serious error.

House Organ

Council of Ironfoundry Associations. The General Bulletin for June reviews the coke situation, examines the question of starting foundry concerns, and gives a warning as to the stock position of linseed oil. For the first time in history, there is published the output of iron castings by districts. The East and West Midlands are together responsible for about a quarter of the total production of the country. For the second, third, fourth quarters of last year and the first quarter of this the output figures for grey iron were 599,364, 610,162, 684,458 and 602,356. Malleable production was steady at between 22,000 and 25,000 tons. In 1946, ironfoundries consumed 325,000 tons of coal and 799,400 tons of coke.

The Bulletin quotes paragraphs of commendation on Platt Brothers & Company, Limited, Dobson & Barlow, Limited, and Tweedales & Smalley (1920), Limited. An offer of help is put forward to those concerns experiencing difficulty in getting supplies of yellow pine. Finally, there is a note on the coal situation. This is among the best of the Bulletins so far issued.

Institute Elects New Members

At a meeting of the Council of the Institute of British Foundrymen, held at the Albert Hall Institute, Nottingham, on June 17, the following were elected to the various grades of membership:—

FIRST LIST

As Subscribing Firm Member

Douglas (Kingswood), Limited, Bristol, engineers and ironfounders (representative, D. Robertson).

As Members

E. W. Bennett, die-casting technician; H. A. Bryant, metallurgist and works manager, Light Castings, Limited, Boksburg, S.A.; M. P. Crowe, foundry foreman; J. G. Cummins, foundry manager; W. Davis, director, Benoni, S.A.; E. Freer, A.M.I.Mech.E., foundry production manager; R. D. Griffith, assistant foundry superintendent; T. Hall, A.M.I.Mech.E., works manager; A. Menzies-Murray, works manager; R. R. Hargraves,* foundry equipment manufacturer.

As Associate Members

J. Williams, A.R.San.I., engineer and manufacturer; S. Atherton, charge hand and brass moulder; A. E. Bloor, foreman moulder; S. J. Downing, foreman iron moulder; R. Ferrie, moulder, Benoni, S.A.; K. L. Futter, foreman patternmaker, Germiston, S.A.; H. H. Hostler, cupola foreman, and E. Keegan, foundry inspection foreman, Britannia Iron & Steel Works, Limited, Bedford; J. Naylor, foundry manager; M. Radford, foundry representative; T. Rothwell, foreman moulder; J. Russell, foreman patternmaker; K. C. Sen, B.Sc.(Met.), metallurgist; M. J. Shannon, patternmaker; J. T. Spencer, patternshop foreman.

As Associates (Under 21)

L. Allison, apprentice patternmaker; S. R. Cooke, apprentice patternmaker.

SECOND LIST

As Members

J. A. Dunn, foundry manager; S. H. Alston, director, Poole Foundry, Limited; O. Partington, general foundry manager, George Bethell, Stockport.

As Associate Members

C. Dibley, metallurgist, A. & G. Price, Limited, New Zealand; J. B. Logan, foundry chemist, Jackson, Elphick & Company, Limited; F. V. Badami, locomotive superintendent, Junagadh State Railway, India; W. Woodhouse, foundry foreman, Poole Foundry, Limited; W. Airey, moulder and coremaker, Baker Perkins, Limited.

THIRD LIST

As Members

G. Burgess,* melting-shop manager, and F. Waller,* assistant foundry manager, Hepworth & Grandage, Limited.

As Associate Members

D. E. Willis, technical assistant, Prince-Smith & Stells, Limited, Keighley; C. Wormald, foreman brass moulder, Albert Taylor & Sons (Valves), Limited, Huddersfield.

As Associate (Under 21)

A. Cracknell, technical assistant, Catton & Company, Limited, Leeds.

*Transferred.

New Catalogues

Electric Hoists. The Whiting Corporation of Harvey, Illinois, U.S.A., have sent us an 8-page catalogue which describes and illustrates a new line of electric chain hoists. A smart little bit of arithmetic shows that under American conditions, a hoist costs 25 cents per day, a sum paid out to a helper every 12 mins. Data will be sent to our readers on writing to America.

Workshop Furnaces. A 6-page leaflet received from Wild-Barfield Electric Furnaces, Limited, Watford, makes good use of two-colour printing to illustrate and describe two types of workshop furnaces. One is of vertical and the other horizontal construction. Both can attain a temperature of 1,050 deg. C., and are useful for tool hardening, carburising, and vitreous enamelling.

Aluminium Alloys. High Duty Alloys, Limited, of Slough, have sent us a 62-page catalogue very largely made up of data sheets. The earlier part (33 pages) carries information pertaining to Hiduminium wrought alloys, and the second part (Section B) to the products of the foundry. There are initially useful tables which correlate Hiduminium alloys with D.T.D. specifications. It is the type of trade literature which will be found to be equally useful to the engineering buyer and the design office.

Book Reviews

Statistics for Beginners

"Engineering Statistics," by G. W. Stubbings, endeavours to explain some of the conceptions of statistical theory. The treatment, within the limits which must be set by the space available in a 15-page booklet, is clear, and the use of the cumulative frequency distribution is a commendable feature. In an introduction of this character, however, a bibliography may be advisable—in this book only one work is mentioned. The book is published by Emmott & Company, Limited, 31, King Street West, Manchester, price 2s.

Plastics in Industry. By A. E. Williams. Published by Emmott & Company, Limited, 31, King Street West, Manchester, 3. Price 2s. 6d. net.

The competition which castings are supposed to experience from plastics has not, so far, given the foundry sales manager many headaches, but it has provided the works executives with new problems to solve. So far the manufacturers of plastics have been good customers. This little book, divided into three chapters, tells of the newer and stronger plastics which are promised a real place in engineering. The book details the practice currently used for the machining and grinding of plastics, which, to us, appears but little different from the handling of metals. Founders making castings for this industry will find this book of real interest.

V. C. F.

House Organs

Malleable Iron Facts, No. 28. Issued by the [American] Malleable Founders' Society. While perhaps not quite so incisive in its appeal as some of the earlier bulletins, this one carries on its cover a picture of a tractor and trailer shifting an outsize girder. Inside is shown the running gear assemblies, with the components which have been made as malleable castings clearly shown.

Industrial Welfare and Personal Management—Service Bulletin No. 15. Issued by the Council of Ironfoundry Associations, Derbyshire House, Belgrove Street, London, W.C.1.

This issue is especially valuable, as it sets out, almost as a specification, a code for washing facilities in industry. It has been prepared by a Committee of Imperial Chemical Industries, Limited, and is essentially practical.

Light Metals Research, Vol. VIII, No. 13. Issued by: Intelligence Department, The British Aluminium Company, Limited, Salisbury House, London Wall, E.C.2.

This issue gives several abstracts of current British and foreign technical literature, including references to a rapid method of electrolytic polishing, a survey of metallurgical research in Japan during the war, and data on the viscous behaviour of grain boundaries in metals.

Welding Research. Issued by the British Welding Research Association, 29, Park Crescent, London, W.1.

This is a résumé of four recent reports on various phases of welding techniques, summarising data published in "Welding Research," the new official organ of the B.W.R.A., which is associated with "Transactions of the Institute of Welding." The subjects cover strength of spot welds in m.s. sheet, welded stanchion joints, welded constructions under fatigue loading conditions and the heat-treatment of welded constructions. Copies of the reports may be obtained from the secretary of the Association.

Publications Received

The Story of Electric Welding. Published by "Sheet Metal Industries" for the British Electrical and Allied Manufacturers' Association, 36-38, Kingsway, London, W.C.2. Price 1s.

It is difficult to realise that there are so many types of electric welding, the most popular of which is fusion welding. This is used by the foundry industry for reclaiming slightly defective motor car items, baths and fractured components. The others—resistance, spot, roller seam, projection, and butt and flash welding—are mainly used in the mass production of engineering components. This excellently illustrated 64-page pamphlet details the achievements and potentialities of electric welding in both war and peace.

Metal Box Company Seeking New Capital

The Metal Box Company, Limited, have made application to the Capital Issues Committee for permission to raise additional finance, states Sir Robert Barlow, chairman of the company, in a statement accompanying the annual report. Plans are in hand for extensions or improvements to buildings and for considerable replacement of plant, likely to involve expenditure of upwards of £3,000,000 over the next three years, and the board has decided that the most appropriate course would be to provide the money partly by a *pro rata* issue of ordinary shares to ordinary stock holders and partly by the issue of new redeemable cumulative preference shares to be offered to all stock holders. An extra-ordinary meeting will be held on July 17 to approve the creation of 1,500,000 4 per cent. redeemable cumulative second preference shares and an additional 200,000 ordinary shares.

On the question of tinplate supplies Sir Robert says that while they are not entirely dependent on tinplate it remains by far their most important raw material. Restrictions on its use continue as acutely as during the war and are a gravely limiting factor, not only on their own activities, but on all those industries which must use a tinplate container for their products. The ultimate solution, he says, lies in the new strip mills. The company welcome the formation of the Steel Company of Wales and the news that work has begun on this great scheme. Until the new mills are ready they remain dependent on the old-type mills for an increase in supply of tinplate.

Sir Robert states that the company's production during the year under review has been at a record high level, despite the fuel crisis in February. Sales amounted to over £16,000,000. Because of the restrictions on the use of tinplate, over 70 per cent. of the company's production in this country is for the packing of foodstuffs.

Ironstone Workers' Five-day Week

Agreed terms for the introduction of the five-day working week in the Cleveland ironstone mines were disclosed by Mr. R. Ewart, M.P., divisional organiser, at a recent meeting of the Council of the Cleveland Miners' and Quarrymen's section of the National Union of Mineworkers at Middlesbrough. Under the new arrangement which, subject to the ratification of the National Joint Board of the Iron Ore Industry, comes into operation on July 21, surface workers will work a 44-hr. week spread over five days, and underground workers a 40-hr. week. Full attendance during the normal working week will be necessary to qualify for the 16 per cent. bonus, plus cost-of-living payment to pieceworkers and an additional shift payment as bonus to timeworkers.

Mr. Ewart expressed the hope that the new agreement would attract more labour to the mines, and that they would soon be in full production. Already, he said, former Cleveland miners were returning to the industry, and Polish labour was being recruited.

John Fowler & Co., (Leeds), Ltd.

A further step in the rationalisation of the heavy Diesel tractor and oil engine industry was announced last week. It will be recalled that Marshall Sons & Company, Limited, recently acquired the control of John Fowler & Company (Leeds), Limited, with the intention of extending the production of heavy Diesel tractors into the crawler range. In order to provide the necessary production facilities and achieve the concentration on this objective, an agreement has now been made between John Fowler & Company (Leeds), Limited, and Associated British Engineering, Limited, whereby the latter acquire the whole of the goodwill including stock in trade and work in progress of the oil engine section of John Fowler & Company. The internal combustion engine products of the Associated British Engineering group of companies are sold by Associated British Oil Engines, Limited, and its export subsidiary, British Oil Engines (Export), Limited. These companies are the sole sales concessionaires for Mirrlees, Petter, Cub, Petter-Fielding and McLaren. J. & H. McLaren, Limited, will take over the Fowler engine business and arrangements are being made whereby the existing engine commitments of John Fowler & Company (Leeds), Limited, will be met by Associated British Oil Engines, Limited.

In due course, the engines that will be manufactured by John Fowler & Company (Leeds), Limited, will be those specially required for installation in those products of the Marshall group based on the Field Marshall tractor engine.

Research Facilities for Scotland

The decision to make representations to the Government urging the provision of adequate research facilities in Scotland was made by the Scottish Regional Council of the Federation of British Industries at their quarterly meeting in Glasgow. It was pointed out that the majority of Government-sponsored research stations were located in the south-east of England. The Council maintained that Scotland offered the conditions necessary for the establishment of the proposed Mechanical Engineering Research Station in respect that it had universities, technical colleges, libraries, and a wide range of active technical societies, as well as an outstanding tradition in engineering and shipbuilding. The co-ordination and development of research on raw materials was also recommended.

Obituary

MR. GEORGE JOHN WELLS, for many years superintendent of the armour department at the Vickers Works, Sheffield, of the English Steel Corporation, Limited, has died at the age of 75. Following the Battle of Jutland, in 1916, Mr. Wells was called in by the Admiralty to report on the resistance of modern armour to heavy gunfire. He had spent most of his career at the Vickers Works, after some experience at the Sheffield works of John Brown & Company, Limited.

Personal

MR. JAMES BROWN, one of the original directors of Allied Ironfounders, Limited, has retired.

MR. P. L. CRAWFORD has resigned from the board of W. H. Dean & Son, Limited, engineers, etc., of Burnley.

MR. J. L. ADAM has been elected president of the Institute of Welding, and DR. J. H. PATERSON, vice-president, for 1947-48.

MR. H. W. PASTEUR and MR. A. GREENFIELD, members of the staff of J. & E. Hall, Limited, engineers and ironfounders, of Dartford, have been appointed to the board.

MR. HOWARD BECKE, who has been elected a director of John Readhead & Sons, Limited, shipbuilders and engineers, of South Shields, has been with the company 37 years, and for the last 11 years has been secretary.

MR. F. L. TOPHAM, who recently resigned his position as foundry manager with the Stanton Ironworks, Co. Limited, in order to take up a similar position with Tweedales & Smalley (1920), Limited, is now residing at 8, Moorgate Avenue, Bambford, Rochdale.

LORD MCGOWAN was elected president of the British Standards Institution at the annual meeting on June 27. He succeeds LORD WOOLTON in this position. SIR CLIFFORD PATERSON, F.R.S., has been elected chairman of the General Council in succession to SIR WILLIAM LARKE.

MR. W. J. MCLAUGHLIN has been appointed secretary of the Aluminium Development Association, in place of MR. DAVIES, who has resigned. MR. J. C. BAILEY has been appointed technical officer, while a further appointment is that of MR. P. G. STUDHOLME to the editorial department of the Association.

DR. EMRYS WILLIAMS, lecturer in electrical engineering at King's College, Newcastle-upon-Tyne, for 10 years, has been appointed Professor in Electrical Engineering at Bangor University. Before taking up his appointment at King's College, he was in the research laboratory of the General Electric Company, Limited.

MR. J. S. MCCALL and MR. C. N. BROWN have been appointed directors of Baker Perkins, Limited, manufacturing engineers and ironfounders, of Peterborough, in succession to MR. R. E. BAKER, who has resigned from the board owing to demands made upon his time by the company's American interests, and the late Mr. L. H. King.

MR. EDWARD SMALLEY, deputy chairman and joint managing director of Tweedales & Smalley (1920), Limited, textile-machinery makers, of Castleton, Lancs, has completed 50 years' connection with the company. To mark the occasion, he entertained at lunch in the works canteen on June 27 100 former employees, several of whom have themselves served the concern for 50 or more years and are now retired.

MR. T. H. MARTIN-HARVEY and MR. CHARLES PIPKIN have resigned their positions as deputy chairmen of British Insulated Callender's Cables, Limited, following the completion of the initial work arising from the amalgamation. MR. W. H. MCFADZEAN and MR. P. V. HUNTER have been appointed deputy chairmen as from July 1, Mr. T. H. Martin-Harvey will continue as a director of the company, but Mr. Pipkin, at his own request, has resigned from the board.

MR. J. HERBERT ASTON, one of the original directors, has retired from the board of Tube Investments, Limited. MR. M. A. WOLFF has resigned his seat on the board of the parent company, but retains his appointments with the subsidiary companies. MR. E. AUSTYN REYNOLDS, on assuming his executive duties with the projected company merging the group's aluminium interests with those of the Hawker Siddeley Aircraft Company, Limited, has relinquished his appointment as an assistant managing director, but retains his seat on the board. MR. MARKWAY R. REEVE has been elected a director of the company.

Wills

WRIGHT, CAPT. HENRY FITZHERBERT, of Yelderley Hall, Ashbourne, Derbyshire, late chairman of the Butterley Company, Limited £38,105

BAKER, A. G., a buyer and sales manager of the Redbourn Works, Scunthorpe, of Richard Thomas & Baldwins, Limited, and formerly with the Shelton Iron, Steel & Coal Company, Limited, Stoke-on-Trent £4,121

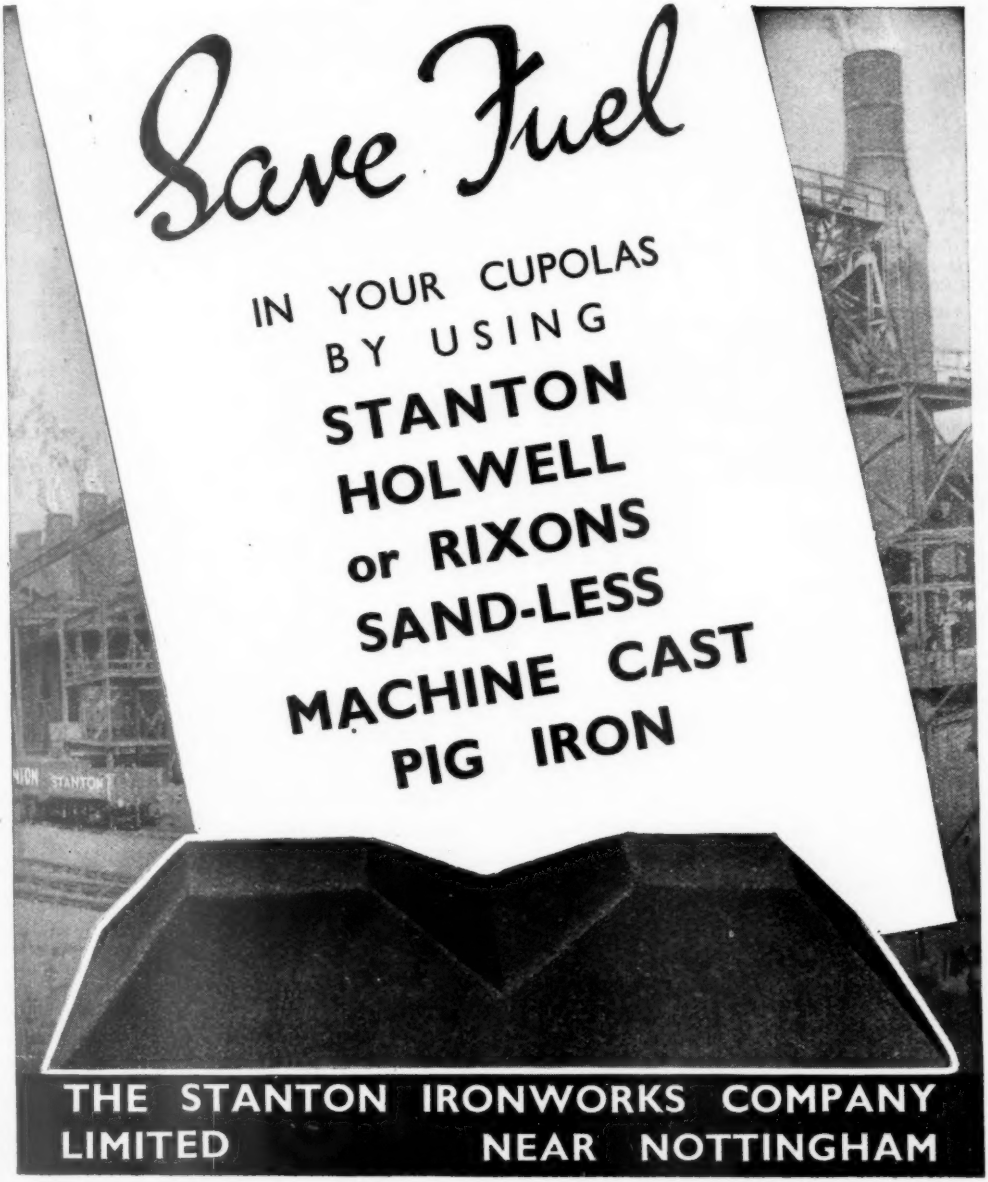
Staggered Hours for Engineering Industry

Some 2,000,000 workers are directly affected by the agreement reached last week by employers and unions in the engineering industry on conditions for working staggered hours to relieve the electricity load at peak hours during the winter months. The agreement brings to an end a long period of deadlock and was reached after concessions had been forthcoming from both sides.

The agreement between the Engineering Employers' Federation and the Confederation of Shipbuilding and Engineering Unions means that the unions have agreed to Saturday morning work at normal rates where it is necessary to make up a normal working week under a staggered hours plan, and to work normal hours at normal rates for any period between 7 a.m. and 8 p.m. Usual night rates will be paid for all night work. Detailed arrangements on hours will be made locally.

APPLICATIONS TO VISIT the Leipzig Autumn Trade Fair which will be held from September 3 to September 7, should be addressed to the Board of Trade, German Division, I.C. House, Millbank, London, S.W.1, not later than July 31.

THE ANNUAL CONFERENCE of the Institute of Vitreous Enamellers will be held on November 6, 7 and 8, at the Grand Hotel, Birmingham. Hotel accommodation is already being booked for this period and persons wishing to attend are advised to make early reservations.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News in Brief

ALL BRANCHES OF THE Polish iron and steel industry are reported to have exceeded their estimated plan for May, 1947. The output of the steelworks was 16 per cent. more than the average monthly output in the peak year of 1938. The output of pig-iron in May last equalled that of an average month in 1938.

THE COPPEE COMPANY (GREAT BRITAIN), LIMITED, received an order for the whole of the coal-handling, crushing, washing and flotation plant for the Margam Works of Guest Keen Baldwins Iron & Steel Company, Limited. They are also to build for the National Coal Board a battery of 20 of the latest Coppée underfired compound ovens at Coedely, Glam.

A POST-WAR CHECK on requirements of overseas buyers of U.K. engineering products, which is being conducted by the technical and overseas division of the British Engineers' Association, is reported to be showing encouraging results and accumulating a mass of useful and up-to-date information regarding the export market. It is anticipated that the survey, covering 83 countries, which was commenced in February last, will be completed by the end of August.

MR. GORDON JACKSON, managing director of the Engineering Centre, which is due to open in Glasgow in September, has just returned from a three weeks' visit to Sweden, when he had the opportunity of setting forth the aims and objects of this new project to the four governing associations. Mr. E. Bruce Ball, another director, has been speaking on the subject during an extensive tour of the East Coast of Africa, Egypt and Palestine, while a third director, Mr. Iain M. Stewart, has recently visited Portugal.

A RESOLUTION PASSED unanimously at the annual conference of the Amalgamated Engineering Union named new wages demands. It urged that negotiations should be pressed forward with speed to obtain interim decisions in line with the general policy on the resolved wages structure. The resolution called for a national minimum consolidated rate, an increase in the piecework minimum to 33⅓ per cent., a bonus agreement which would relate all timeworkers' earnings to piecework earnings, and the conversion of certain grades of workers at present designated as semi-skilled into skilled grades as a preliminary to obtaining three main grades named in the new wages structure.

THE TREASURY has made an Order under Section 10 (5) of the Finance Act, 1926, as amended by subsequent enactments, continuing for six months the exemption from key industry duty of all articles exempted from that duty by previous Orders which expired on June 30 last, with the addition of 2-3 butylene glycol and xenylamine, and with the deletion of dicyandiamide, didial (ethyl morphine diallyl barbiturate), and copper methyl arsenate. Copies of the Order, which contains the list of all the goods, entitled the Safeguarding of Industries (Exemption) (No. 3) Order, 1947, may be obtained from H.M. Stationery Office, York House, Kingsway, London, W.C.2, or through any bookseller (S.R. & O., 1947, No. 1236, price 1d.).

Parliamentary

Scientific and Technical Man-power

When MR. G. THOMAS asked the Minister of Labour what further steps he was contemplating taking to ascertain the probable future demands of Governmen. departments, industry, research and teaching upon the scientific and technological man-power of the country, MR. NESS EDWARDS said that, at the Minister's request, Lord Hankey had agreed that the Technical Personnel Committee, which, under his chairmanship, performed valuable services during the war in assessing the demand and supply in science and technology, should institute a number of detailed inquiries of the kind referred to. These inquiries were being conducted by specially appointed panels representative of all the interests concerned, and the results would be published in due course. It might be added that at the request of the Advisory Council on Scientific Policy recently appointed by the Lord President, a survey was also about to be made of the existing man-power in the country in the fields of science and professional engineering. This survey would be carried out by the Technical and Scientific Branch of their Department with the assistance of the appropriate scientific bodies and professional insti utions.

Steel Export Allocations

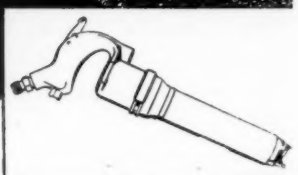
MR. ARTHUR WOODBURN (Parliamentary Secretary to the Ministry of Supply), in a written reply to MR. ASSHETON, said that the Government policy was to make as large a contribution as possible from all industries to the export drive, while assuring to home industry essential supplies for their re-equipment and development. The percentage of foundry equipment exported was low. Structural steelwork was exported almost entirely for projects of urgent importance to our own economy. The various allocations were periodically reviewed as supplies were assessed. The issue of allocations was now being resumed in the light of the expectation of improved supplies of coal to the steel industry.

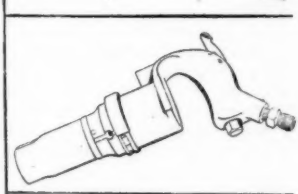
Control of Metals and Ores

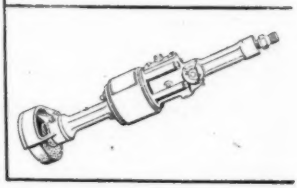
MR. KEELING was told, in a written answer by the MINISTER OF SUPPLY, that the following metals were imported or bought exclusively by the Ministry:—Chrome ore, lead, zinc, copper (blister and electrolytic), virgin aluminium, pig-iron and steel. The metals and ores which had been released for private importation, subject to licence, were:—Aluminium scrap, antimony, bauxite, cryolite, iron powder, manganese, molybdenum, silicon, tungsten, vanadium, and zinc concentrates.

Aluminium Scrap Recovery and Disposal

In reply to MR. CHETWYND, the MINISTER OF SUPPLY said that 185,000 tons of aluminium scrap had been recovered at Government metal-recovery depots, and 44,000 tons sold. The remainder had been melted down to secondary aluminium ingot. The metal was used during the war in the manufacture of aircraft and afterwards for the aluminium house.







World famous for their Riveting hammers, Holmans also produce a range of pneumatic tools. **Riveting Hammers.** The "X" series has long been the first choice for medium work. Now the "ER" group has been added to the range: the ER's are heavy duty tools capable of closing cup rivets of all sizes up to $1\frac{3}{8}$ in. **Chipping & Caulking Hammers.** These are tools that all operators like to use and the full range enables the right tool to be used for the right job. The Throttle Valve gives full control of weight of strike from light taps to full force blows. The adjustable Exhaust Deflector and the sensible grip make for comfortable working. **Grinding & Fettling Tools.** The Rotogrind series gives a choice of tools with a wide variety of application. 0/1 is the high speed job. Its weight is 4 lbs. all on and it will rev up to 19,000 P.M. Its light weight makes it a first-class tool for such delicate jobs as die dressing and its power and speed make it suitable for much general purpose work. Sizes 2 and 4 will take any grinding or fettling work that comes their way, their power/weight ratio is very high and they are the ideal tools to carry fast cutting wheels. No. 5 is the Surface Type grinder and fettler, ideal for fettling large castings, and smoothing off welds.

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New Companies

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

Allton & Partners, 7, Lincoln's Inn Square, London, W.C.1—Engineers, etc. £2,000. A. G. B. and B. A. M. Allton.

Alexander Kenyon & Company (Western), 16, Chapel Street, Salford, 3—Engineers, plant manufacturers, etc. £5,000.

Owen Tracey, Brougham Road, Worthing—General engineers. £10,000. H. F. and M. J. Owen, and R. C. Tracey.

Apis Engineering & Research, 23, Coleman Street, London, E.C.2—£1,000. H. P. Schofield and P. Podolier.

E. V. Deeley & Company, Spout Lane Factory, Walsall—Ironfounders. £2,500. A. P. Jones and E. V. Deeley.

George & Miller, 1a, Elfort Road, Highbury, London, N.5—Engineers, etc. £1,200. H. E. George and J. Miller.

Chas. Stibbe & Company—Engineers, toolmakers, etc. £4,000. G. H. Chase, 2, Lyon Court, Pembroke Road, Ruislip.

A. Reeves & Company, 22, Highfield Lane, Keighley, Yorks—Engineers, etc. £2,000. A. T. Reeves and F. H. Bateman.

Rushton Engineering Company, 1a, Salcott Road, Battersea, London, S.W.11—£1,000. P. Tatlow and F. R. Lockwood.

Hunter & Coombes, Broadlands Garage, Gas Works Lane, Newport, I.O.W.—Machinery merchant, marine engineer, etc. £3,500. F. E. Hunter and H. F. Combes.

Priest & Reed, 7, Broad Weir, Bristol, 1—Manufacturers of pulley blocks, chains, cables, etc. £5,000. R. H. Splaine, H. G. Priest, W. E. Richards, and J. Burleigh.

W. D. Vick, 28, Station Road, Acocks Green, Birmingham, 27—Electrical, electronic and mechanical engineers, etc. £3,000. W. D. Vick and R. A. Williams.

A. E. Harris & Son, Cowden Cross Works, Cowden, Kent—Agricultural and mechanical engineers, etc. £2,000. A. E., A. S., and G. M. Harris, and A. C. Sherwood.

G. N. Ainsworth & G. O. Stevenson, 90, Deansgate, Manchester, 3—Manufacturers of engineering supplies, etc. £1,000. G. N. Ainsworth and G. O. Stevenson.

H. M. T. Engineering Company (Wolverhampton), School Road, Tettenhall Wood, Compton, near Wolverhampton—£2,000. F. W. Molineux, A. H. Holt, and C. E. Teale.

Pinhoe Engineering & Foundry Company, Chancel Bridge, Pinhoe, nr. Exeter—£15,000. C. C. Evans, H. Hoare, D. R. and R. A. R. Saunders, S. B. Stedham and J. Petts.

Moats Components Company, 33, South Audley Street, London, W.1—Precision engineers, tool makers, etc. £10,000. A. T. E. Binsted, T. H. Youds, and T. H. Griffith.

Le Bryan Group Products (Great Britain), 372, High Road, Tottenham, London, N.17—Manufacturers of machinery, tools, etc. £10,000. C. A. Bryant and W. J. E. Lee.

Humphries-Simons Engineering Company, Wagon Works, 78, London Road, Chippenham, Wilts.—£5,000. W. A. and H. M. Humphries, and H. S., A. C., and L. M. Simons.

William Edward Thorne, 125, High Holborn, London, W.C.1—Manufacturers of wrought and cast iron, bronze and other metals, etc. £1,000. W. E. and A. Thorne.

Cowlishaw, Walker & Company

Proposals to reorganise the capital of their subsidiary company, Cowlishaw, Walker & Company, will be considered at the annual meeting of Norton & Biddulph Collieries, Limited, to-day (Thursday). Under the proposals, the directors will be authorised to (*a*) reconstitute and reorganise the capital of Cowlishaw, Walker & Company so as to consist of 1,000,000 shares of 1s. each, all of one class; (*b*) increase the capital of the subsidiary company to such an amount as shall be decided by the directors of that company; (*c*) convert the subsidiary company into a public company and procure the adoption by it of new articles of association; and (*d*) sell all or any of the 600,000 issued shares of 1s. each in the capital of the subsidiary company resulting from such reorganisation to members of the company *pro rata* as nearly as may be to the number of shares of the company held by them respectively and at such price as the directors of the company may consider proper.

Market Research and Export Trade

Speaking at the annual luncheon of the British Export Trade Research Organisation recently, Sir Stafford Cripps, President of the Board of Trade, said that market research was the factual basis for developing our export trade. We were on the verge of a period when we should have to rely not only on the quantity and quality of our goods but also upon our power of salesmanship and of adaptation to a particular market. The old "take it or leave it" attitude was quite impossible in the changed markets of to-day. He hoped they would see a rapid expansion of the services of B.E.T.R.O., and he announced that the Government, with whose approval and encouragement the organisation was set up, had agreed to help it financially by paying half of any deficit which might be incurred in any year's operation over the next five years.

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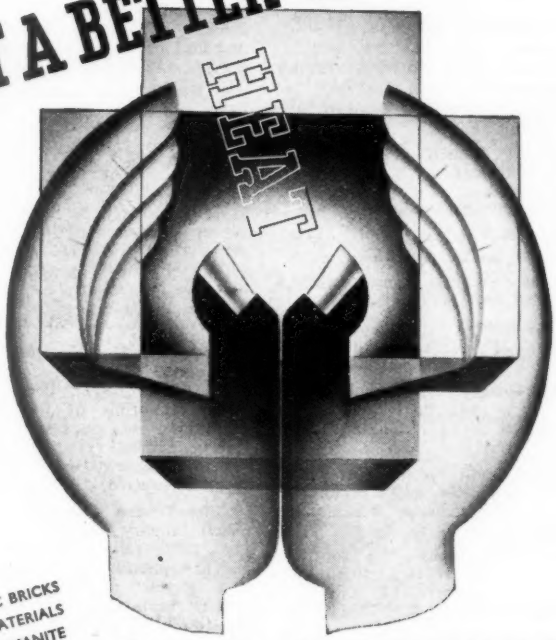

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Company News

(Figures for previous year in brackets.)

John Ormerod & Sons—Dividend of 10% (nil).

Beans Industries—Interim dividend of 10% (same).

Aluminium Corporation—Maiden dividend of 10%.

Zinc Investments—Final dividend of 2% (2½%), making 4½% (5%).

Ward & Goldstone—Final dividend of 30% (20%), making 50% (35%).

Masson, Scott & Company—Dividend of 5% (same) and bonus of 1¼% (same).

Richard Thomas & Baldwins—Final dividend of 10% (12½%), making 15% (12½%).

Gerrard Industries—Final dividend of 10% and bonus of 5%, making 25% (same).

W. & T. Avery—Final dividend of 10% (same) and bonus of 5% (nil), making 20% (15%).

John Brown & Company—Final dividend of 9⅛% (6⅜%), making 12½% (10%), all tax free.

Electric Furnace Company—Second interim dividend of 4½% (second interim and final dividend of 4½%).

Francis Morton & Company—Final dividend of 7½% (same) and bonus of 2½% (5%), making 17½% (20%).

Aluminium Castings Company—Final ordinary dividend of 25%, making 32½% (nil); final dividend on the preferred ordinary shares of 8½%, making 15⅝% (nil).

Petrie & McNaught—Net profit for the year ended April 30, £15,135; to directors' fees, £500; preference dividend, £3,771; final ordinary dividend of 6%, making 10%; forward, £40,570 (£33,753).

Fricker's Metal & Chemical Company—Net profit for 1946, £41,819 (£5,794); dividend of 10% (6%) and bonus of 5% (nil); to general reserve, £23,000 (nil); pensions reserve, £5,000 (nil); forward, £2,839 (£1,682).

Pyrene Company—Net profit for 1946, £163,292 (£244,323); to tax, £98,000 (£204,500); reserve, nil (£20,000); pensions, £5,000 (£4,000); three interim dividends totalling 24% (same); forward, £81,919 (£36,752).

Chamberlin & Hill—Net profit to March 31, £17,616 (£10,096); final dividend of 20%, making 30% (same); general reserve, £2,500 (same); to reconstruction and development fund, £614 (deferred repairs and contingencies, £2,000); forward, £14,190 (£5,139).

Johnson, Matthey & Company—Net profit for the year ended March 31, after tax, etc., £73,942 (£88,536); to goodwill, £25,000 (same); staff fund, £3,500 (same); final dividend of 3% (same) and bonus of 6% (same), making 12% (same); forward, £391,049 (£384,217).

Barton & Sons—Net profit for 1946, after taxation, depreciation, etc., £56,451 (£64,859); final dividend of 4%, making 7% (same); capital redemption reserve, £7,219 (£6,977); general reserve, £12,000 (£20,000 to dividend equalisation fund); forward, £30,053 (£28,449).

G. N. Haden & Sons—Net profit for 1946, £15,201 (£14,029); E.P.T. recoverable, £19,300 (£79,000); to income tax, £9,600 (£43,000); general reserve, £2,333 (nil); balance of contingencies no longer required transferred to general reserve, £12,667; dividend of 25% (same); forward, £140,277 (£139,925).

Bentley Engineering Company—Net profit for 1946, after £30,942 (£19,771) dividends from subsidiary and associated companies and war bond interest and £96,628 (£71,587) for taxation, £51,740 (£25,994); dividend of 40%, less tax (20%, tax free); to contingencies, £15,000 (nil); forward, £26,400 (£21,772).

Fuller's Earth Union—Net profit to March 31, after depreciation, etc., but before tax, £83,061 (£83,590); to taxation and deferred repairs, £46,000 (£60,884); general reserve, £10,000 (£8,681); final dividend of 11% and bonus of 5%, making 20% (17½%, including bonus of 2½%); forward, £21,820 (£7,545).

Herbert Terry & Sons—Net profit for 1946, after depreciation, etc., £82,419 (£66,968); to equalisation of dividends, £10,000 (£5,000); reserve for contingencies, £10,000 (£30,000); general reserve, £30,000 (nil); final dividend of 1s. per share, making 1s. 6d., or 30% per 5s. share (dividend of 20% and bonus of 5%, making 35%); forward, £27,807 (£26,051).

Ruston & Hornsby—Group trading profit for the year ended March 31, after depreciation, taxation, etc., £499,717 (£351,932); debenture interest, etc., £21,738 (£22,517); profit of the parent company, £431,946 (£281,853); income tax, £147,297 (£132,686); pension reserve, £15,000 (£10,000); contingencies, £60,000 (nil); general reserve, £60,000 (£37,812); dividend of 12½% (same); forward, £100,324 (£76,350).

Allen West & Company—Trading profit for the year ended January 31, £180,662 (£95,873); additional trading profits relating to previous years, £44,862 (nil); E.P.T. estimated net recovery, nil (£16,000); dividends and interest on investments in subsidiaries, £5,757 (same); to taxation, £104,043 (£21,577); debenture interest, £7,108 (£8,691); directors' fees, £3,000 (same); pensions, £8,757 (£6,751); depreciation, £20,000 (£10,000); land and buildings written off, nil (£9,952); deferred repairs, nil (£5,000); sinking fund, nil (£4,788); net profit, £88,373 (£47,771); to general reserve, £20,359 (£15,000); dividend of 7½% (same) and bonus of 2½% (nil); forward, £91,445 (£56,947).

EDMUNDS, WALKER & COMPANY, LIMITED, distributors of ball and roller bearings, etc., of Hendon, London, N.W.9, are to apply to the Council of the London Stock Exchange for quotation for the whole of the issued 600,000 shares of 5s. each.

UNDERWRITING HAS BEEN completed of an offer for sale to be made shortly by Electric & General Industrial Trusts of 600,000 ordinary stock units of 1s. each in Lehmann, Archer & Lane, Limited, manufacturers of engineers' tools, taps and dies, of Matlock. The units will be offered at 13s. 6d. per unit

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Raw Material Markets

Iron and Steel

By the introduction of a five-day week and other wage concessions it is hoped to attract more labour to the Cleveland ironstone mines and raise the output figures, which are at present at a low level. More ironstone, as well as more coke, will be needed when two blast furnaces at present being re-lined are ready for re-lighting. Meanwhile, basic-iron production for the steelworks is barely maintained and then only at the cost of a shortage of low-phosphorus iron. There is, in fact, a heavier demand for all grades of pig-iron, though limited tonnages of refined iron are still being exported.

Rather better supplies of semi-processed steel have been reaching the re-rolling mills during the past few weeks, and operations have consequently been on a more satisfactory scale. This is only partly due to increased outputs from British steelworks, imports have also been on a rather better scale. Nevertheless, sheet mills are still rather badly off for bars, though slabs are fairly plentiful and there are plenty of outlets for crops and defectives. Prime billets are still scarce and costly.

Pressure for steel plates, particularly the lighter gauges, is quite unabated, and there is little chance of any more orders being accepted for delivery before the end of Period III. Shipbuilders are badly in need of steel plates and angles, and, in fact, the pressure for all classes of constructional material is quite exceptional. An enormous volume of orders is in hand for sheet steel, and most of it is being delivered either black or painted, galvanising facilities being limited. Demand for sheets far exceeds the supply and there is a wide demand for rails and colliery equipment.

Non-ferrous Metals

The Ministry of Supply has announced the following interim allocations of tin metal by the Combined Tin Committee for the second half of 1947:—Australia, 103 tons; Austria, 22; Canada, 300; Ceylon, 8; Chile, 29; Czechoslovakia, 161; Denmark, 119; Egypt, 76; Finland, 35; France, 1,515; India, 525; Ireland, 7; Italy, 657; New Zealand, 42; Norway, 90; Palestine, 16; Philippines, 4; Poland, 239; Sweden, 293; Switzerland, 225; Turkey, 90; U.S.A., 6,750; and Uruguay, 25, making a total of 11,331 tons.

The quantity of tin metal which will become available for allocation during the second half of this year is expected to be considerably greater than the total now being distributed and further allocations will be announced on or about August 20. The present interim allocations are intended to ensure that there shall be no interruption in the movement of supplies from producing areas, pending receipt by the Committee of complete reports from consuming countries on past consumption and future requirements. The allocations have been determined on approximately the same basis as those announced by the Committee on March 18. They represent, however, the allowances due to each country after deduction, where applicable, of amounts over-purchased against previous allocations. The amounts over-purchased by some countries exceed the new interim allocations to which they would otherwise have been entitled. Such countries may expect to receive allocations later in the year.

Supplies may be obtained from the United Kingdom (on behalf of Malaya and Hong Kong), the Netherlands, Belgium, China, Siam, and the United States (for stocks of Japanese tin only). Detailed information as regards procurement may be obtained from the Secretaries of the Combined Tin Committee or from the Directorate of Non-Ferrous Metals.

The Committee has announced also that all procurement against first-half allocations should be completed by July 31, 1947, at which time unsold tonnages will revert to the pool for re-allocation, unless buyers and sellers can show that there are extenuating circumstances warranting extension of time for individual cases.

Buyers, both in this country and abroad, are limiting purchases of copper as much as possible, but it has been confirmed that custom smelters have recently disposed of some copper at 20¼ cents per lb. (£112 per ton), f.a.s., and this would seem to indicate that the British price is due for a heavy fall in the future.

Contracts Open

The dates given are the latest on which tenders will be accepted. The address is that from which forms of tender may be obtained.

Dorset, July 31—Central-heating and domestic hot-water installations, structural steel, metal windows, etc., for the County Council. Mr. C. P. Brutton, clerk of the county council, County Hall, Dorchester.

Haverfordwest, July 28—Construction of approx. 3,700 yds. of spun-iron pipe, varying from 3 in. to 6 in. dia., etc., for the Rural District Council. John Taylor & Sons, Artillery House, Artillery Row, Westminster, London, S.W.1. (Fee £2, returnable.)

Hemel Hempstead, July 21—Supply and laying of approx. 1,750 yds. of 12-in. dia. and 2,080 yds. of 9-in. dia. spun-iron pipes, etc., for the Borough Council. Edward Sandeman, Kennard & Partners, consulting engineers, 1, Victoria Street, Westminster, London, S.W.1. (Fee £3 3s., returnable.)

Oundle and Thrapston, July 17—Provision and laying of about 10 miles of 3-in. and 4-in. spun- and cast-iron pipes and specials, etc., for the Rural District Council. Pick, Everard, Keay & Gimson, 6, Millstone Lane, Leicester. (Fee £2 2s., returnable.)

Strood, July 31—Construction of approx. 17 miles of concrete tube and stoneware pipe sewers and 1⅛ mile of spun-iron pipe sewers and rising mains, etc., for the Rural District Council. Mr. F. W. S. Stanton consulting engineer, 5, Victoria Street, Westminster, London, S.W.1. (Fee £5, returnable.)